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FIRE ANT PREDATION ON MONARCH LARVAE (NYMPHALIDAE: DANAINAE) IN A CENTRAL TEXAS PRAIRIE

Additional key words: milkweed, population dynamics, *Danaus plexippus, Asclepias oenotheroides, Solenopsis invicta.*

Little quantitative data concerning the means by which the monarch butterfly (*Danaus plexippus* L.) repopulates eastern North America exist. Our qualitative understanding of this process is essentially this: large monarch populations migrate southward from major breeding grounds located between the Rocky Mountains and the Atlantic Ocean north of ca. latitude 40°N at the end of summer (Urquhart 1987). Some fraction of these butterflies reach the overwintering grounds in central Mexico around the beginning of November (Calvert & Brower 1986). Due to predation, starvation, and desiccation at the overwintering sites, an even smaller number remigrate in the spring to the southern United States and presumably northern Mexico where they lay eggs on newly sprouted asclepiads to form the first spring generation (Malcolm et al. 1993). Here the population decline prevalent during late fall and winter reverses itself, and monarchs begin to increase in number. The monarch population is thought to build during each subsequent summer generation with major increases occurring at the end of summer in the northern breeding grounds. Basic factors such as the phenology and size of the migration, yearly variations in population size, and the pathway of travel from breeding to overwintering grounds and return are poorly understood.

I began the study reported here to determine the phenology of host plant use by monarch butterflies on a previously uninvestigated prairie milkweed (*Asclepias oenotheroides* Cham. & Schlecht., Asclepiadaceae), the distribution of which is southern—largely confined to Texas, Mexico, and Central America (Woodson 1954). My goal was to estimate reproductive success by examining the number of larvae reared successfully in a dense milkweed field in south-central Texas. The study was never completed because no larvae completed their development on this species. Fire ants (*Solenopsis invicta* Buren, Formicidae) appeared to consume all monarch larvae and eggs.

During the spring of 1995, I monitored a field of *A. oenotheroides* for the presence of monarch eggs and larvae at the Baptist Children's Ranch, located in the Blackland Prairies approximately 10 km southeast of Luling, Texas. The 0.99 ha pasture was visited 5 times between 29 March and 8 May, an average of every 9.75 days (Table 1). This 41-day period extended from the time when faded monarchs returning from Mexico were widely reported to the Texas Monarch Watch hotline (an 800 number service where information about the presence and abundance of monarchs in Texas and Oklahoma is exchanged) until none was being reported in central Texas. *Asclepias oenotheroides* stem densities were determined by the point-centered quarter method (Cottam & Curtis 1953). Stations were positioned every 10 m along two transects that ran perpendicular to each other through the center of the field. Egg and larval densities were determined by dividing the product of host plant stem density and the number of eggs or larvae by the number of stems examined.

Monarch egg and larval densities and *A. oenotheroides* stem density are shown in Table 1. *Asclepias oenotheroides* density started at about 1000 stems/ha, rose to nearly 4000 stems/ha, and stabilized at about 2600 stems/ha. The high density recorded on 7 April included many seedlings. The estimated number of eggs started at 508/ha on 29 March, peaked at 1243/ha on 7 April as the main group of returning migrants migrated through, and fell off as the migrants left the area. With the exception of the first count on 29 March, the number of adults observed during the count period corresponds well with the number of eggs counted (Table 1). The low adult number on 29 March is likely due to unseasonably cold weather that occured on that date.

With appropriate delays for time to develop, these eggs were expected to hatch and

TABLE 1. Estimated densities of *Asclepias oenotheroides* plant stems, *Danaus plexippus* eggs, larvae and adults in a 0.99 ha pasture near Luling, Texas. Total adults refers to the number of monarchs observed in the field during the ca. 2 hour period when data were taken.

Date	Total eggs	Egg density (eggs/ha)	Total larvae	Larval density (1st instars/ha)	Larval density (later instars/ha)	Stem density (stems/ha)	Stem height	Total adults
29 March	33	510	2	31	0	1047	5.87	1
7 April	20	1243	1	62	0	3729	7.78	23
15 April	5	206	0	0	0	2638	10.76	1
26 April	2	53	0	0	0	2569	10.74	0
8 May	1	47	0	0	0	2619	12.40	0

larvae were expected to proceed from instar to instar with fewer numbers in each subsequent stadium due to predation (Malcolm et al. 1987). However, no second or later instars were ever observed on any of the plant stems sampled.

Fire ants arrived in Mobile, Alabama from Brazil during the 1920s (Drees & Vinson 1993). Now, 70 years later, they have spread through much of the southern United States from North Carolina to Texas, an area where monarchs returning from Mexico are expected to lay eggs that will become the first spring generation (Malcolm et al. 1993). Fire ants are especially prolific on Texas prairies where their colonies are polygyne (multiply queened) (Porter et al. 1991) and may reach densities of 2000 mounds/ha (Drees & Vinson 1993). Fire ants specialize on arthropods (Porter & Savignano 1990) and have a reputation as voracious predators, even on vertebrates as large as cotton rats. Numerous anecdotal and published accounts document declines in arthropod populations as diverse as lone star ticks, chiggers, and cotton flea hoppers that occurred after the arrival of fire ants (Killion & Vinson 1995). In the vicinity of Austin, Texas, the abundance of lepidopterans has fallen to 50% of pre-fire ant levels (Durden, pers. comm.). Species most affected are those that feed near the ground on herbs or grasses. Durden argues that the decline in herb- and grass-feeding lepidopterans is due to fire ant predation.

On April 7, using the same stations employed by the point-centered quarter method to estimate host stem density, fire ant mound density was estimated to be 1011 mounds/ha. Occasionally stems of *A. oenotheroides* were found growing up through the mounds.

Fire ant presence on *A. oenotheroides* also was noted during the 41-day period. Approximately 4% of host plant stems examined for eggs or larvae had fire ants patrolling stems or leaves. Only a few spiders and no other predators were observed. On 29 March, a first instar larva was observed being attacked by fire ants on its host leaf. This incident is the only direct evidence that fire ants preyed upon monarchs during the study period. Fire ants were never observed in the process of removing or attacking eggs. There remains the possibility that other organisms or abiotic factors are responsible for the high rates of mortality observed. Nonetheless the overwhelming presence of fire ants in the field and their reputation as voracious predators suggests that they are the major factor in the failure of the monarchs to mature.

The location and distribution of prairies in the midwest with respect to those in Texas suggests that monarchs that breed on central Texas prairies and plains are the progenitors of monarchs that will breed on the prairies of Oklahoma, Kansas, Nebraska and further north (Malcolm et al. 1993). If the devastation of the population of monarchs oviposited on *A. oenotheroides* near Luling, Texas is indicative of what is occurring on *A. oenotheroides* located elsewhere and on other milkweed species used by monarchs, the first spring generation reared within the fire ant zone must make only a small contribution to the monarch recolonization of North America. No evidence exists as yet for similar effects in areas east of Texas where fire ants are also abundant, but eastern fire ants colonies are mostly monogyne (single-queened) and are not as dense as in Texas (Porter et al. 1991). Strong selection pressure may presently be in operation for monarchs returning from

Mexico to avoid areas of intense fire ant infestation and oviposit in fire ant-free areas to the north or west of the fire ant zone.

To my knowledge, this is the first empirical study that strongly implicates the imported fire ant in a negative impact on the population of the monarch butterfly.

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